International Textile and Apparel Association (ITAA) Annual Conference Proceedings

2017: Anchored by our Past, Navigating our Future

Jan 1st, 12:00 AM

Comfort and Aesthetic Properties of Bacterial Cellulose for Textile Applications

Jennifer Harmon
University of Wyoming, jlharmo@gmail.com

Logan Fairbourn
University of Wyoming, lfairbou@uwyo.edu

Natalie Thibault
University of Wyoming, nthibaul@uwyo.edu

Comfort and Aesthetic Properties of Bacterial Cellulose for Textile Applications

Jennifer Harmon, Logan Fairbourn, Natalie Thibault, University of Wyoming, USA

Keywords: Bacterial Cellulose, Hand, Uniformity, Absorbency

Introduction. Cotton is one of the most popular cellulosic fibers, with 17 million bales produced in the U.S. in 2012 (National Cotton Council of America, 2013). Recently, there have been textile developments undertaken aiming to replace cotton as the primary source of cellulose in textile products (Textile World, 2013). In addition to the wood pulp based fibers, bacterial cellulose (BC) has been investigated as a potential source of cellulose.

Literature Review. Unique properties of bacterial cellulose include increased tensile strength and water absorbing capability (El-Saied et. al., 2008). These improved properties are a result of the net of fine fibers that the bacterial cellulose forms (El-Saied et. al., 2008). Bacteria from the Acetobacter genus are among the highest producers of BC. Research with this material has mainly investigated specialty end uses such as artificial skin and blood vessels (Klemm et. al. 2001; Krystynowitcz et. al., 2000). Recently, this material has been investigated for potential use in apparel (Wood, Liu & Salusso, 2015; Lee & Ghalachyan, 2015). Several limitations to the material exist, including the material's stiffness, lack of consumer familiarity and lack of consistent thickness. The purpose of this study was to extend previous work by investigating aesthetic and comfort properties of bacterial cellulose grown and dried in a variety of conditions.

Experiment Methodology. A bacterial strain from the ATCC, #10245, was cultivated for this study. This bacterium was propagated for 1 week in test tubes before being transferred to larger growing containers for an additional week. The bacterial broth was evenly distributed into containers of different media. All broth and test media were autoclaved at 120 degree Celsius for 20 minutes before bacterial addition. Growing containers were transferred to an incubator at 30 degrees Celsius for 21 days. Once the cellulose growth period was complete, these mats were treated with a 1% NaOH solution to purify the cellulose. These treated mats were rinsed with distilled water until a neutral pH was reached. Half of the samples were then placed in a 96 hour glycerol soak. After this soak, the cellulose was rinsed again. Half of the samples were air dried at 72 degrees Fahrenheit and half were freeze dried at -32 to -42 degrees Fahrenheit.

Images. ***Air Dried*** ***Air Dried with Soak*** ***Freeze Dried*** ***Freeze Dried with Soak***

Qualitative Results. *Visual Quality.* Pictures were used to evaluate visual quality. Photos of the four different conditions can be seen above. All of these photos come from cellulose grown in the most productive medium, molasses mannitol. *Hand.* Test method AATCC-EP5 was used to evaluate hand with a 2 in by 2 in sample of fabric. Of the evaluated cellulose samples, those rated highest for pliability (M= 6.75) on the 7 point semantic differential scale were the soaked and freeze dried Molasses and High Fructose Corn Syrup varieties. These samples were ranked similarly in terms of softness as well, receiving the highest rank for softness (M= 6.00). However, High Fructose Corn Syrup samples that were soaked and air dried were most likely to be described as limp (M= 1.5). Due to the stiffness of the air dried only cellulose, this material was left out of the initial perception testing.

Quantitative Results. *Uniformity.* When comparing the points of measurement taken from each material before samples were cut, the most uniform bacterial cellulose mat was from the soaked, air dried High Fructose Corn Syrup Mannitol condition. This mat was also the thinnest and had an average thickness difference between 4 points of measure of .0005 mm. *Water Absorption.* AATCC 79-2010 was used to evaluate water absorption with three, 100 mm by 100 mm samples from each type of cellulose. The most absorbent cellulose came from the non-soaked, freeze dried High Fructose Corn Syrup condition.

Conclusion. While this unique material has potential for textiles and apparel use, several limiting factors must be addressed. Our results indicate that air drying with no pretreatment does not produce suitable material for textiles and apparel. Additionally, this nonwoven material did not prove to be sufficiently absorbent for textile and apparel use due to the lack of water spread observed in the absorbency test.

References.

El-Saied, H., El-Diwany, A. I., Basta, A. H., Atwa, N. A., & El-Ghwas, D. E. (2008). Production and characterization of economical bacterial cellulose. *Bioresources, 3*(4), 1196-1217.

Lee, Y.A. & Ghalachyan, A. (2015). RETHINK: Wearing kombucha in Santa Fe. Creative Scholarship presented at the annual meeting of the International Textile and Apparel Association, Santa Fe, New Mexico.

Klemm, D., Schumann, D., Udhardt, U., & Marsch, S. (2001). Bacterial synthesized cellulose—artificial blood vessels for microsurgery. *Progress in Polymer Science, 26*(9), 1561-1603.

Krystynowicz, A., & Bieleck, S. (2001). Biosynthesis of bacterial cellulose and its potential application in the different industries. *Polish Biotechnology. News*.

National Cotton Council of America (2013, October). *Which country grows the most cotton?* Retrieved from: http://www.cotton.org/edu/faq/.

Textile World (2013, October 8). Finland to lead the way as a designer of cellulose-based products. Retrieved from: http://www.textileworld.com/textile-world/textile-news/2013/10/finland-to-lead-the-way-as-a-designer-of-cellulose-based-products/

Wood, D., Liu, H. & Salusso, C. (2015). Production and characterization of bacterial cellulose fabrics. Poster presented at the annual meeting of the International Textile and Apparel Association, Santa Fe, New Mexico.